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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	2/9/04	Initial issue. Collected/expanded on topics in other ESM chapters; added new topics (backfit, D&D, specs); App A (SD)	Tobin Oruch, <i>FWO-DO</i>	Gurinder Grewal, <i>FWO-DO</i>
1	6/9/04	Refined designer, temporary definitions; added code of record documentation; revised "conflict;" revised constants; added MEL population; clarified output submittals and programmatic applicability; added various spec requirements, Buy American Act guidance.	Tobin Oruch, <i>FWO-DO</i>	Gurinder Grewal, <i>FWO-DO</i>
2	5/18/05	Updated Definitions. Added Applicability section. Under Code of Record section, added new rules for projects underway superseding LIR. Under Design Output, clarified sealing of design. Under Repairs & Alterations, changed 50% rule to IEBC for building systems. Changed variance requirements based on IMP 311. Under Quality Requirements, added more references. App A became ESM Ch 14. Changed FWO to successor orgs.	Tobin Oruch, <i>ENG-CE</i>	Gurinder Grewal, <i>ENG-CE</i>
3	2/1/06	Added Design Goals and life cycle costing guidance (App E). Added drawing CM category suggestions (App A) and baseline deliverables tables (to App B) formerly in CM LIR along with MDL requirements. Added Shed requirements. Added 15-30-60-90/100 requirements (App C). Added App D, FDD Requirements. Relocated interpretation and variance section and attached forms from Ch 1 Section 100. Deleted detailed backfit requirements now in AP. Minor changes based on indep external review: 3.0.B; 11.2.G – calcs per QAP or use LANL's procedure. Updated references (IMP, ISDs, spec section numbers).	Tobin Oruch, <i>ENG-CE</i>	Mitch Harris, <i>ENG-DO</i>

PLEASE CONTACT THE ESM GENERAL POC
for upkeep, interpretation, and variance issues

Section Z10	<u>General POC/Committee</u>
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LANL Eng Standards including this one: <http://engstandards.lanl.gov>

Z1010 ADMINISTRATION (PROGRAMMATIC & FACILITY)

Where appropriate, guidance is provided to aid in the implementation of requirements. Guidance will be *italicized* text or otherwise clearly indicated. All other text in regular type indicates mandatory requirements unless prefaced with wording identifying it as guidance or a recommendation.

1.0 APPLICABILITY

- A. The Engineering Standards are **Mandatory Documents** and apply to all Lab personnel and subcontracted personnel performing design, fabrication, repair, replacement, and construction services for LANL – both programmatic and facility – including maintenance and modification of existing equipment and facilities and new facilities and equipment. The Engineering Standards implement DOE Order and Contract requirements. For additional definition on applicability see [IMP 342](#), Engineering Standards.
- B. Personnel shall not deviate from the LANL Standards in developing the technical project requirements (including programming documents, F&OR and other, and performance criteria), in design, in practice (execution), or in written direction to any contractor unless the Standards Program has formally granted such variance to the project as described later in this Section Z10.
- C. Project managers shall ensure that subcontracts for design or construction require compliance with applicable portions of the Standards.

2.0 ACRONYMS AND DEFINITIONS

Acronym	Definition
AE (or A/E)	Architect-Engineer. A design agency, normally not within LANL, but including the SSS (e.g., KSL).
AHJ	<p>Authority having jurisdiction. Per IMP 342, Engineering Standards, this is the ENG Chief Engineer for all but fire/life safety and NEC/electrical safety matters relating to design and construction.</p> <p>To further illustrate the AHJ role, the Chief Engineer is the AHJ for the application of the mechanical and plumbing codes, although he historically has delegated that responsibility to the ES Mechanical POC by way of ESM Chapter 1. However, since the LANL Fire Marshal is the AHJ for fire protection, neither the Chief Engineer nor the ES Fire POC would be the AHJ for related issues. Likewise, since the Electrical Safety Committee was appointed the AHJ for NFPA 70-National Electric Code by the Director, neither the Chief Engineer nor the ES Electrical POC would be the AHJ for those issues.</p>
Building official	The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative [Int'l Building Code 2003]. At LANL, this is the Engineering Division Leader. The ENG DL is authorized and directed to enforce the provisions of the IBC and broader Engineering Standards. ENG does this through design reviews and field inspections, and those in ENG performing such work are

Acronym	Definition
	delegated the ENG DL's authority to act on the DL's behalf. Additionally, LANL Eng Standards interpretation authority is delegated to the ENG Chief Engineer and, subsequently, the Standards Discipline POCs.
Consider	When used in a guidance (e.g., italicized) statement, it is suggesting the designer look at and think about following the guidance offered. When "consider" is used in a requirement statement it strongly indicates that LANL does not want the suggestion dismissed out of hand. Good practice is to document the thought process of this consideration, particularly when rejecting the suggestion partially or wholly. In some cases in the ESM, documentation is specifically required (e.g., design notes or memo to file); in other cases, submittal of such documentation for approval is required.
Constructor	The entity performing fabrication or physical construction activity
Contractor	The entity performing the work, including one or more of the following: design, offsite fabrication, or onsite construction or maintenance. This may be the SSS, another contractor, or a LANL M&O employee. Term used in specifications and elsewhere.
CSI format Specifications	The numbering and 3-part format defined by the Construction Specifications Institute's MasterFormat and SectionFormat documents (see LMS below).
DCP	Design Change Package, a design change control mechanism for nuclear facilities. Ref ISD 341-1 Engineering Program Manual.
Design agency	The LANL organization or subcontractor (A/E) responsible for the preparation of engineering design and documentation [from IMP 342].
Design authority	The individual appointed by the responsible division leader, Facility Director, or program manager to be responsible for the implementation of all laws, DOE Orders, national codes and standards, and LANL ES required for the engineering activities in their functional area of responsibility. [IMP 342]
designer	Anyone working in a design agency capacity, whether engineer, architect, drafter, or designer.
DM	Drafting Manual (short term for LANL Drafting Standards Manual, LDSM)
ECN	Engineering Change Notice, a design change control mechanism for non-nuclear facilities. Ref ISD 341-1 , Engineering Program Manual.
ENG	LANL Engineering Division
ES	Engineering Standards
ESM	LANL's Engineering Standards Manual, ISD 342-1, of which this section is a part
F&OR	Functional and Operational Requirements. F&ORs are "developed from the Mission Need, Program Requirements Documents, and specific facility characterization data to more concisely quantify and qualify project requirements. [LANL PMD Proc 301]

Acronym	Definition
Facility	A synonym for Real Property and Installed Equipment. RP&IE is the land, improvements on the land such as buildings, roads, fences, bridges, and utility systems and the equipment installed as part of the basic building construction that is essential to normal functioning of a building space, such as plumbing, electrical and mechanical systems. This property/equipment is also referred to as institutional or plant and was formerly known as Class A. [DOE Order 4330.4B] Note: In nuclear space, DOE O 420.1 and 10CFR830 uses this term to include the programmatic activities that occur within the facility also.
FDD	Facility Design Description: Document that identifies top-level functions and requirements associated with SSCs; provides basis requirements and describes features of the facility; Describes simple, less important systems without having to develop separate SDDs (e.g., potable water system); refers to individual SDDs for details on critical systems
hazard category	For nuclear, the DOE-STD-1027 category (1, 2, or 3). For non-nuclear, per LIR 300-00-05 , Facility Hazard Classification (High, Medium, Low, Office): <ul style="list-style-type: none"> • High Hazard: The hazards analysis shows the potential for significant offsite consequences. (DOE STD 3009 Chg Notice 2) • Moderate Hazard: The hazards analysis shows the potential for significant on-site consequences (DOE STD 3009 Chg Notice 2) • Low Hazard: The hazards analysis shows the potential for only significant localized consequences (DOE STD 3009 Chg Notice 2)
Important to safety	Here, those defense-in-depth SSCs in addition to SC and SS [DOE-STD-3009 and 10CFR830]
LMS	LANL Master Specifications in LMS Manual ISD 342-2 . These CSI numbered/formatted specifications address construction-type work and maintenance (maintenance examples: piping repairs and testing, carpet and other like-for-like replacements). Formerly titled LANL Construction Specifications Manual from 1990's through 2005.
M&O	Management & Operating, as in the prime contractor running LANL (e.g., LANS)
MDL	Master Document List: a database of the engineering and facility related documents. Such listings are the responsibility of the ENG-ITS Document Control and Records Management Team at their TA-63 facility. At present, drawings are mirrored in the online MOADS system, and floor plans of record also have a stand-alone webpage .
MEL	Master Equipment List: an online database of installed equipment (SSCs) that require maintenance or surveillance. At present, the MEL is in the PassPort/CMMS system for most facilities.
ML	management level: defined in LIR 230-01-02 , Graded Approach for Facility Work (or Programmatic equivalent) and AP-341-502 , Management Level Determination and Maintenance Management Program. <i>Guidance:</i> Related LIG .

Acronym	Definition
Nonreactor nuclear facility	Those facilities, activities, or operations that involve, or will involve, radioactive and/or fissionable materials in such form and quantity that a nuclear or nuclear explosive hazard potentially exists to the workers, the public (all individuals outside the DOE site boundary), or the environment, but does not include accelerators and their operations and does not include activities involving only incidental use and generation of radioactive materials or radiation such as check and calibration sources, use of radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and X-ray machines.
POC	Point-of-Contact
Priority document	Defined in ISD 341-1 Eng Program Manual, a design output document required to be maintained for any SSC that performs a safety function or is required to respond to facility emergencies. Often required by Alarm Response, Emergency, or Abnormal Operating Procedures; to determine plant event compensatory actions; or by Technical Safety Requirements (TSR) to clarify technical requirements. As a minimum, P&IDs, electrical single lines, operating procedures, surveillance procedures, and the Master Equipment and Master Document Lists in nuclear and moderate/hazard facilities, but may also include panel schedules, emergency evacuation diagrams, floor plans of record, and other documents at RDL discretion. Timetable for incorporation of changes is per ISD 341-1, but is typically after the field work is complete and before operations can be released, with possible 30 day extension.
Programmatic	A synonym for Personal Property and Programmatic Equipment. PP&PE is equipment used purely for programmatic purposes, such as reactors, accelerator machinery, chemical processing lines, lasers, computers, machine tools, etc., and the support equipment dedicated to the programmatic purpose. This property/equipment is also referred to as organizational, research, production, operating or process and was formerly known as Class B. [DOE Order 4330.4B]
Project	Any activity involving the installation, modification, or permanent removal of an SSC at LANL. Includes related fabrication, construction, procurement, and maintenance activities.
RDL	Responsible Division Leader. Current term for the division leader responsible for the safety operation of one or more facilities.
RFP	Request for Proposal, a solicitation to bidders that includes the technical scope of work.
Safety Class (SC) SSC	A nuclear facility term, <i>Safety class structures, systems, and components</i> means the structures, systems, or components, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from safety analyses. [10 CFR 830: § 830.3 Definitions.]
Safety-related	See Safety SCC below
Safety SSC	A term meaning safety class, safety significant, and safety-impacting ML-1 and ML-2 SSCs; any of these could potentially impact worker or public safety or the environment if they failed.

Acronym	Definition
Safety Significant (SS)	Structures, systems, and components not designated as safety-class SSCs but whose preventive or mitigative function is a major contributor to defense in depth (i.e., prevention of uncontrolled material releases) and/or worker safety as determined from safety analyses. [10 CFR 830: § 830.3 Definitions, except parenthetical note.] As a general rule of thumb, safety-significant SSC designations based on worker safety are limited to those SSCs whose failure is estimated to result in an acute worker fatality or serious injuries to workers. Serious injuries, as used in this definition, require medical treatment for immediately life-threatening or permanently disabling injuries (e.g., loss of eye, loss of limb) from other than standard industrial hazards. It specifically excludes potential latent effects (e.g., potential carcinogenic effects of radiological exposure or uptake). [DOE-STD-3009 Chg. 1]
SDD	System Design Description: Document that provides detailed description of SSCs; identifies requirements associated with SSCs; provides bases for requirements to explain why they exist; describes features of system design provided to meet requirements.
shall	Denotes a requirement. [DOE O 6430.1A] "Must" denotes the same. ("Will" is sometimes used to convey LANL actions, often in specifications for a Contractor).
shall consider	Requires that an objective assessment be performed to determine to what extent the specific factor, criterion, guideline, standard, etc., will be incorporated into or satisfied by the design. The results and basis of this assessment shall be documented. Such documentation shall be retrievable and can be in the form of engineering studies, meeting minutes, reports, internal memoranda, etc. [6430.1A]
SSC	Structure, system, or component
SSS	LANL's Support Services Subcontractor (KSL at time of writing)
Standard Drawings and Details	The repeatable details contained in ISD 342-3
temporary (and permanent)	See Section Z1030 in this document
VSS	Vital safety systems are safety-class systems, safety-significant systems, and other systems that perform an important defense-in-depth safety function.[DOE-STD-1073]
WSS	Work Smart Standards, a set of contractual documents on Environmental Health and Safety. Currently contained in Appendix G of the Lab's DOE contract. http://labs.ucop.edu/internet/comix/

3.0 CODES AND STANDARDS

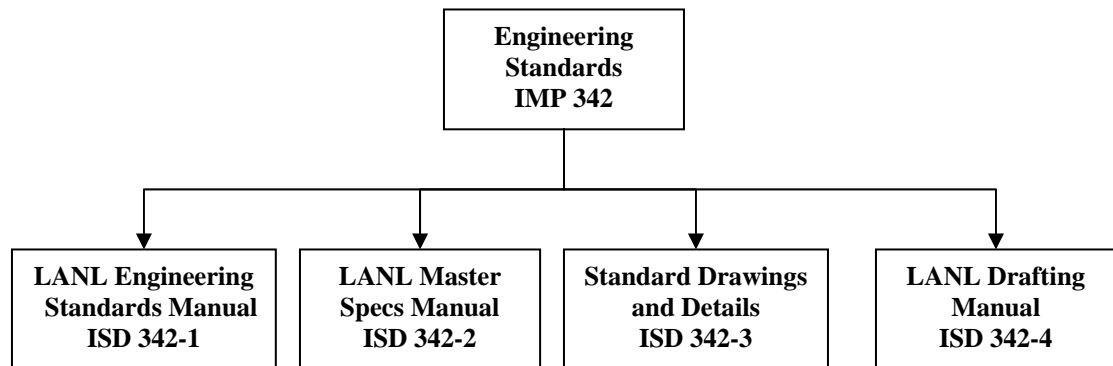
- A. Comply with the applicable portions of the latest edition and addenda of each code, standard, and DOE Order invoked by the ESM and LANL contract (*typically in Appendix G*) unless the ESM indicates a particular edition (referring here to actual ESM requirements, not citations of codes/editions in footnotes, endnotes, or other commentary).

- B. If the ESM specifies a later edition than the LANL Contract, follow the ESM¹. Contract: <http://labs.ucop.edu/internet/comix/>
- C. Comply with the International Building Code 2003 edition (follow 2006 only if specifically required by the LANL/DOE or project's contract; do not use 2006 only because another ESM chapter states or implies latest edition). Follow IBC exceptions shown below and in related ESM chapters (primarily Structural, Architectural).
- Where the IBC refers to the ICC Electrical Code substitute the ESM Electrical Chapter (includes National Electrical Code®). Where the IBC refers to the International Fire Code substitute the ESM Fire Chapter (includes NFPA National Fire Codes). Where the IBC refers to plumbing or mechanical codes, substitute ESM Mechanical Chapter and the codes it invokes.
 - Administrative sections in Chapter 1 of the IBC related to permits and fees do not apply at LANL; however, inspections shall be performed including those in Chapter 17, Structural Tests and Special Inspections. (Supercedes related statement in ESM Ch 4 B-C_GEN).
 - Buildings and structures designed and constructed to fully meet the requirements of NFPA-101, Life Safety Code, shall be considered to have met the "life safety" requirements of OSHA, 29 CFR 1910, IBC, and all other codes²
- D. NFPA codes and standards except NFPA 5000. For NFPA 70 (NEC), follow edition as required by ESM Chapter 7, but in any case no earlier than 2002. NOTE: If LANL/DOE or project contract states an edition, then that governs if later than ESM edition.
- E. Follow all applicable Codes of Federal Regulation (CFRs), latest edition. *These are federal agency requirements that have the force of law. Rules, Orders and Laws can be found at:* http://engstandards.lanl.gov/engrman/HTML/Universe_links.htm
- F. For national and DOE standards, in general, if a standard is required, then its "shall" statements must be followed if applicable – but "should" statements need not be followed to be in conformance with the standard. If, however, the ESM or LMS specifically mandates optional or non-mandatory sections of national/DOE-type standards, then those sections become required for LANL work.
- G. **Online Codes and Standards:** Access to selected online national codes and standards are available to anyone with a LANL IP address or "smart card" at: <http://lib-www.lanl.gov/infores/stand/stanihs.htm>

¹ ESM adoption process will ensure later edition is as conservative as LANL Contract and otherwise preferable.

² Basis: [LIR 402-900-01, LANL Fire Protection Program](#) (§6.1.4; WSS), also J. Streit memo, (EMRef 24.)

(Note: EMref refers to a Standards Program internal filing system for hard-to-find references.)



3.1 LANL Engineering Standards

A. LANL Engineering Standards Manual (ESM), ISD 342-1

Guidance: This chapter's section number (Z10) and most other chapters are organized by the UNIFORMAT system promulgated by the Construction Specifications Institute (CSI), described in ASTM E1557, and summarized in ESM Chapter 12, Nuclear, App A.

B. LANL Master Specifications Manual (LMS), ISD 342-2

1. See Subsection on Specifications later in this Section Z10.
2. Programmatic work: LMS sections required for programmatic work are those referenced in ESM sections designated for programmatic.
3. NOTE: LMS sections were being renumbered to the CSI MasterFormat 2004 system in February 2006. ESM references to the sections are being correcting gradually; in the meantime, a crosswalk from old to new numbers/titles is available on the specs webpage.

C. LANL Standard Drawings and Details, ISD 342-3

1. This include the "ST-" series repeatable details and example drawings.
2. Comply with standard detail drawings unless indicated as guidance in the ESM (e.g., italicized detail title). Edit the details to reflect the particular details of the project by delete portions that in no way apply. Do not delete potentially-applicable requirements without ESM Discipline POC approval.

D. LANL Drafting Manual, ISD 342-4

1. Comply with the LANL Drafting Manual when creating or revising drawings for facility projects. *Guidance: This manual does not address weapons design work covered by ESA Division procedures. Use of the LANL Drafting Manual is recommended for programmatic work.*

The above manuals are available at: <http://engstandards.lanl.gov/>

4.0 CLARIFICATIONS, INTERPRETATIONS, ALTERNATES, AND VARIANCES

4.1 Clarifications and Interpretations

- A. Standards users may contact the Standards Discipline POCs directly for assistance (*for major projects, PMD procedures for RFIs govern*). When a written response is appropriate, users shall submit the requests in writing to the POC using email, the ENG Engineering Service Request system, or Form FM1 (Att 1) in accordance with Table Z10-1 below. E-mail links on the Standards webpages are maintained to facilitate communication with the POCs and their alternates when the POC is unavailable.
http://engstandards.lanl.gov/engrman/HTML/poc_techcom1.htm
- B. When clarification or interpretation e-mails or paper requests reach the appropriate POC(s), they shall be responded to promptly (and in writing if received as such).
- C. The POC for each respective technical committee may respond directly to interpretations and clarifications, or first call upon the assistance of the respective technical committee.
Responses should be copied to the ESM Standards Manager and Tech Committee when significant or of interest.
- D. Interpretations and clarifications of general interest to LANL are normally posted on the Standards website via the Standards Manager.

4.2 Alternate Methods, Variances, and Exceptions

- A. Personnel shall not deviate from the LANL Standards in developing the technical project requirements (including programming documents, F&OR and other, and performance criteria), in design, in practice (execution), or in written direction to any contractor unless the Standards Program has formally granted such variance to the project as described below.
- B. Forms and authorities for alternates and variance are summarized in Table Z10-1.
 - 1. Exceptions to the LANL Master Specs, Drafting Manual, Standard Drawings and Details (ST drawings, etc.), and welding procedure specs may be granted in writing by the discipline POC in a manner similar to the interpretation process described above.
 - 2. Variances and exceptions to the ESM proper shall proceed as follows:
 - a. Requestor develops the request, ideally using the ENG Division Engineering Service Request system available from ENG homepage [use of this system allows assignment to responsible POC(s) by ENG Chief Engineer's Office and CE follow-up].
 - As it is in the best interest of LANL to consistently follow the Standards, it is expected that variances will be granted only rarely, and only when a strong justification exists. As such, it is incumbent upon the requestor to provide sufficient justification in their request, and to show that the variance has significant long-term cost savings, programmatic benefit, etc. associated with it.

- b. POC reviews the request, enters into ESR system when available, and makes a decision, which may include one of the following options:
 - i. Concur with the request, as-is (initiate form Section Z10 [Form-FM2](#) Att for requestor if not already initiated); form then requires additional approvals including responsible requesting manager, ENG Chief Engineer, etc.
 - ii. Concur with a modified request (requires same additional signatures)
 - iii. Table the request until additional requested information is specified by the requestor.
 - iv. Reject the request.
 - c. Requestor takes action in accordance with the decision, or, if rejected, appeals to the ENG Chief Engineer (may appeal higher if that fails).
 - C. Review, acceptance, or lack of rejection of design or other submittals not meeting the Engineering Standards or Contract by LANL does not constitute an approved alternate or variance to the Standards – nor tacit approval to continue with non-acceptable work.
 - D. NCR: Alternates, variances, and exceptions are only used for proposed, future work. When work has proceeded contrary to the Engineering Standards, submitted for LANL acceptance, and then discovered to be non-conforming with the Standards or Contract, then a nonconformance report (NCR) shall be submitted by the petitioner and used to disposition the situation and address causes of non-compliance. [Project Management Div Procedure 0313, Nonconformance Reporting](#), [ISD 330-6, Nonconformance Reporting](#), or [Performance Surety Division PS-1 Procedure PD-030.000](#) can be used when more appropriate procedures/forms do not exist. Submit NCR to the applicable POC for disposition concurrence prior to the POC forwarding to the Standards Manager, Chief Engineer, and ENG Division Leader for information (appeal process is same entities in sequence).
 - E. When specifically allowed by ESM sections, the graded/tailored application of codes and standards is not considered a variance to the ESM. When the graded approach is used to define the appropriate methodology for code and standard application, that methodology and rationale shall be formally documented and become part of the project design documents. The applicable LANL Engineering Standards POC is the authority having jurisdiction for approval of the form and content of the documentation. *Example: The graded application of IEEE nuclear standards for safety class electrical work.*
 - F. *Guidance: General-interest (non-project-specific) variance and exception data are normally posted for viewing on the LANL web until such time the exception or variance no longer physically exists, or the ESM is revised to incorporate the exception or variance. Exceptions or variance dispositions for planned incorporation into the ESM should indicate such plans in the web posting.*

Table Z10-1 Clarification, Interpretation, Alternates, and Variances -- Methods, Approvals, and Appeals

	LANL Master Spec, Standard Drawing or Detail, or Drafting Manual			LANL Engineering Standards Manual			LANL Standard by Contract		
	Form	Approve/ Issue	Appeals	Form	Approve / Issue	Oversight/ Appeals	Form	Approve/ Issue	Appeals
Clarification or Interpretation	e-mail	ESM Discipline POC	ENG Chief Engineer (may involve POC and Tech Comm)	ESR, email or Att 1-FM1 of this Section Z10	AHJ (usually the ESM POC shown on website)	ENG Chief Engineer (may involve Tech Comm)	ESR, email, or Att 1-FM1 of this Section Z10	AHJ (usually the ESM POC shown on website)	ENG Chief Engineer (may involve Tech Comm)
Alternate Method	e-mail	ESM Discipline POC	ENG Chief Engineer (may involve POC and Tech Comm)	ESR, email or Att 2-FM2 of this Section Z10	AHJ (usually the ESM POC shown on website)	ENG Chief Engineer, then progressively higher levels of management if necessary	ESR + Att 2-FM2 of this Section Z10	ENG Chief Engineer (may involve POC and Tech Comm)	Progressively higher levels of management
Variance or Exception	e-mail	ESM Discipline POC	ENG Chief Engineer (may involve AD, POC and Tech Comm)	ESR + Standards Variance Form Att 2-FM2 of this Section Z10	RDL + POC + ENG Chief Engineer + ENG Div Leader	Progressively higher levels of management	Memo or other DOE approval of project document clearly showing acceptance	DOE Los Alamos Site Office	DOE HQ

Clarify	To make the ES or referenced code or standard understandable and free from confusion
Interpret	To formally provide an acceptable method of compliance with the ES or referenced code or standard
Alternate Method	A deviation from an ES or referenced code technical requirement that includes compensatory measures that accomplish the desired intent or results intent but using a different approach with alternative materials, design, or methods of construction or equipment
Variance	A deviation from the explicit expectations in the ES or referenced code or standard
Exception	Relief from all or a part of the requirements in the ES or referenced code or standard

5.0 CODE OF RECORD

- A. Code of Record: The codes and standards in effect when design is completed are considered the “codes of record” and often remain an influence for the life of the constructed project. Establishment and maintenance of a facility or system’s design basis during design and construction, including “codes of record” is required (including documentation required by the Structural, Hazardous, and Nuclear Chapters and others). The ENG Chief Engineer is the AHJ for interpretations, conflict resolution, and variances on code-of-record issues (e-mail is acceptable form). *Guidance: The design basis includes the design inputs such as design criteria and codes, plus design decisions captured in studies and calculations. Also see the “Repair, Alterations...” Subsection in this document regarding updating to current codes.*
- B. Projects Underway
1. Project managers shall ensure that subcontracts for design or construction require compliance with applicable portions of the Standards including the following (including by ensuring in subcontracts).
 2. Major projects: For projects performed under the requirements of LIR220-01-01, *Construction Project Management*, the point used for determining the application of the Engineering Standards (code of record) shall be the date of each Request for Proposal (statement of work) that includes A/E design services.
 3. Small Projects: For projects not meeting the criteria above, the date used for determining applicability of new or revised Standards is the managing organizations (e.g., RDL or programmatic line manager) approval to proceed with final or preliminary/final design (or date of RFP for final AE services, if sooner).
 4. Design Shelf-life: For all projects, when the design has been substantially completed but construction has not begun within 12 months, the design shall be evaluated against current LANL standards through documented cost/benefit analysis acceptable to the ENG Chief Engineer and the design updated if warranted prior to beginning construction. Similarly, if the design process is stopped part-way for over 12 months, upon restart it must then be evaluated against the Standards that were effective no earlier than 30 calendar days prior to the date of restart of design.
 5. *Guidance: It is often to a project’s or contractor’s advantage to voluntarily adopt newer standards during design. Newer LANL standards and specs incorporate local and national lessons learned for safety, cost effectiveness, new products, and overseer expectations, and have updated product information and logistical information for working at LANL. These can improve the design, construction, start-up, and operation phases – though there might be added cost of redesign if the newer code or standard is adopted while the design is on-going or complete.*
- C. Variance to “projects underway” section above should include an impact analysis, and follow the normal standards variance processes, except that the final approval is by the ENG Chief Engineer, except where LANL Policy Documents state otherwise.

- D. Code of Record Documentation for Projects: Projects shall document and maintain the specific edition of the codes and standards used as their basis in a project record document once they have reached the “underway” date discussed above (including LANL ESM and specs, DOE Standards, and national and state codes and standards). *Guidance: Producing a CD-ROM of the LANL Standards can accomplish that portion of the whole and greatly aid design reviewers; ENG may produce these upon request.* NOTE: Other parts of the ESM require additional documentation of the code of record. For example:
- *Architectural Chapter 4 Section B-C-GEN requires a drawing sheet that summarizes occupancy classification, type of construction, building areas and number of stories, corridors and area separations, floor and roof loadings, and hazard classifications*
 - *Structural Chapter 5 Section I requires a Design Basis Document;*
 - *Nuclear Chapter 12 (and some Hazard Facilities per Ch 10) requires a detailed design criteria document, SDDs, etc.*
- E. *Guidance: Requests for Proposal (“bid documents”) should state the key design basis codes/editions such as Building Code of Record (e.g., IBC-2003) and Life Safety Code of Record (e.g., NFPA 101-2006).*
- i) *At time of writing LANL Supply Chain Management Division contract provisions specify that the required standards for that contract are those in effect on the date of the solicitation unless the Request for Proposal specifically invokes a different set. See quotation on Contracts under Conflicts section below.*

6.0 “CONFLICTS” AND ADEQUACY

- A. “Conflicts”: The most stringent requirement among the LANL contract with DOE and within all ESM chapters and codes and standards invoked by the ESM shall be followed, even when they might be conflicting. The exception is where a chapter recognizes a conflict and directs how to proceed (*e.g., a chapter may direct use of NFPA Life Safety Code egress provisions in lieu of those in the building code*). Refer questions concerning “conflicts” in the Engineering Standards manuals to the applicable LANL discipline POC. The ENG Chief Engineer has authority to resolve general and multi-discipline issues, and has delegated discipline-specific authority to the ESM Discipline POCs.
- B. “Guidance Conflicts”: Similarly, having a requirement in one place and a guidance statement in another place that is similar or addressing the same issue is not a conflict and the requirement shall be followed (*this is often intentional – practicing technique of having directive in one/best place and referring to it or reiterating it elsewhere; e.g., reference to WSS in 2.0.A “guidance” above*).
- C. Specs “Conflicts”: If the ESM and LMS conflict, the ESM has precedence and the project-specific spec shall be made to complement the ESM by the designer.

- D. Codes and Standards: If a requirement in any LANL document exceeds a minimum code or standard requirement, it is not considered a conflict, but a difference, so comply with the most stringent requirements among the documents. If the same term is defined in the ESM and a code or standard, the term shall have the meaning given it in the ESM. If a term is not defined in a code or standard but is defined in the ESM, the term shall have the meaning given it in the ESM.
- E. Incorrect Standards: The adequacy of all design inputs is the responsibility of the designer/design agency. If the designer believes the LANL Standards (a design input) to be incorrect (e.g., compliance will cause a problem), it is their responsibility to bring the issue to the attention of the applicable ESM Discipline POC (via the LANL Project Manager if appropriate) for resolution.
- F. Complete Design: The engineer/designer is responsible for a complete, coordinated design package (e.g., drawings or sketches, specifications, etc.) as required to meet project specific requirements. Refer questions concerning the contents in the Engineering Standards manuals to the applicable LANL discipline POC. *Guidance: The manuals are not intended to cover all design requirements and construction specifications necessary to provide a complete operating facility or system.* The design organization is responsible to provide a complete design package, including all necessary specifications.

7.0 “CONSTANTS”

Following are “constants” to be used for most design at LANL. These are generally adequate and conservative; however, when other ESM chapters contain other constant values, they take precedence. Also, there may be instances where these or other ESM “constants” are not conservative; then, designer shall use conservative or actual values.

- A. Altitude: 7500 feet
- B. Latitude: 35.9 deg N, Longitude 106.3 deg W (TA-6 weather station)
- C. Barometric Pressure (avg): 11.10 psia (22.65 inches Hg).¹
- D. Air Density (7,500 feet): I-P: 0.057 pounds/cubic foot (0.075 pcf at standard air)³
 - S-I: 0.00091 g/cm³ (0.0012 at standard air/sea level)
- E. Air Density Ratio: $0.075/0.057 = 1.32$ (Reciprocal = 0.76)

Note: Exceptions to the above (where altitude and the other data must be corrected):

1. For mechanical and electrical design for TA-16 use 7780 feet; at TA-57 Fenton Hill site use 8600 feet (both approximate actual elevations). For lower Pajarito Road and other areas use actual elevation when required for adequate design margin.⁴

³ FWO (now ENG) Calculation No. 00-00-CALC-M-0003.

⁴ Basis: Altitude at LANL ranges from 6250 ft at TA-39 to 7780 ft at TA-16. Info from USGS 1:24000 quadrant maps: Frijoles, NM and White Rock, NM. Altitude affects design and operation of many mechanical, electrical, and other components; this effect is addressed in more detail in those ESM chapters.

2. Design “clean” fire extinguishing agents using a design altitude no higher than actual per ESM Chapter 2 and LMS Section 13967 to ensure conservatism.

8.0 DEACTIVATION, DECOMMISSIONING, AND DEMOLITION (D&D)

- A. When designing new systems and facilities, consider how D&D might be performed and design to facilitate it where practical, including waste minimization, recycling, and reuse (*additional requirements for hazardous systems appear in ESM Chapter 10*).

The remaining paragraphs refer to the actual D&D process:

- B. As a minimum, perform D&D to a plan that describes the scope of work, work boundaries, utility de-energizations and locations, and protection of non-scope SSCs.
- C. As appropriate, further describe D&D work using drawings or sketches. *Guidance: Use clouding or other methods as described by the LANL Drafting Manual. The addition of photos in the drawings is a common and helpful technique for helping to describe the work.*
- D. Obtain ENG-DECS or other appropriate LANL engineering group review of D&D plans prior to work initiation.
- E. For electrical demolition refer to ESM Chapter 7 and LMS Section 16095, Electrical Demolition.

9.0 DESIGN ADEQUACY (“BACKFIT”) OF NUCLEAR/HAZARDOUS SSCs

- A. When an existing structure, system, or component (SSC) is upgraded to safety class, ML-1, safety significant, ML-2, or important-to-safety (ITS), the Design Authority organization (*typically the system engineer or their management*) shall perform a formal adequacy analysis. The analysis process shall determine if the SSC complies with the current standards or, if not, establish the feasibility and cost effectiveness of modifying the SSC to comply with current standards.⁵

⁵ DOE 420.1A requires that safety SSCs be designed per the Order and its Guides, and under a quality assurance program that satisfies 10 CFR830.120. The Defense Nuclear Facilities Safety Board (DNFSB) has identified that, in some cases, these existing SSCs designated as safety SSCs have not been evaluated to ensure that they can reliably perform their credited safety function and the SSCs may not satisfy current codes and standards for design or current quality expectations. [from EFCOG White Paper referenced in 8.0.C] Since most existing LANL SSCs would not meet the current Order requirements, design adequacy analysis must be performed.

1. Follow LANL Conduct of Engineering [AP-341-515](#), System Adequacy Analysis.

Guidance: This process has been followed at LANL by WETF, DVRS, TA-55, and elsewhere, and examples are available.

10.0 DESIGN GOALS

- A. Unless stated as otherwise in the project-specific documents, designers shall use the following parameters for decision analysis and design goals:

	Expected Life, years ⁶
Systems	
HVAC control system	10
HVAC/R system components	As shown in ASHRAE Applications manual (Owning and Operation Costs chapter)
Other systems -- active/moving components of systems in architectural, mechanical, electrical, I&C, and nuclear systems	20
Facilities	
Office Trailer	20
Light Construction (e.g., modular, pre-engineered or \$5M maximum facility)	35
Medium Construction (e.g., line item office or lab)	50
Heavy Construction (e.g., bunkers, other concrete-walled/roofed structures)	60

- B. Materials and finishes shall be chosen accordingly.
- C. Difficult-to-replace systems and components shall be designed to perform for the life of the facility with minimal life-extension activity. Examples of such systems and components:
- Ductwork
 - Electrical wiring, conduit, fixtures, transformers
 - Exterior wall finishes
 - Flooring, hard-surface (e.g., ceramic or quarry tile)
 - Mechanical equipment (passive)
 - Piping
 - Structural and architectural components of concrete and metal
- D. For systems and components that cannot be reasonably expected to perform for the system or facility life without replacement or life extension, design for ease of replacement/life-extension.
- E. Systems and Components for which replacement or life extension is anticipated in less than 35 years:
- Electrical equipment with moving parts or contacts
 - Flooring (carpet and vinyl)
 - Mechanical equipment (active -- non-passive)

⁶ Numbers consistent with those being used by Facility Maintenance Div, Maint Eng Group for decision making and modeling per Carr 11/2005. IRS depreciation period for commercial buildings is 39 years; LANL and other government buildings are usually used even longer.

- F. Guidance on life cycle analysis is provided in Appendix E.

11.0 DESIGN OUTPUT REQUIREMENTS

11.1 Project Files -- General

- A. Document design by a set of calculations, drawings and/or sketches, and design/evaluation criteria commensurate with project scope that demonstrate the design is both safe and cost effective. The project file shall include information important to the accomplishment of the design. *This should include significant written correspondence, summary of significant telephone calls, design and design-evaluation criteria whether furnished by LANL or designer-generated, working notes, and calculations.* When the design is complete, there shall be a historical record showing how the design progressed and reasons for changes.

11.2 Calculations

- A. Prepare design calculations to document analytical determinations. Calculations shall be checked, reviewed, sealed when required by the following subsection, signed and dated by the designer and the checker, complete in all respects and shall reflect the basis for selection of systems and components.
- B. Submit calculations to LANL design authority for review and approval as requested or required. This approval does not relieve the designer of any responsibility for correctness and coordination with the drawings and specifications.
- C. The calculations will become record calculations for LANL and may be used in the future for modifications. Room numbers, equipment nomenclature, fixture numbers, zone numbers, or any other designations shall be consistent with those indicated on the drawings or in the specifications.
- D. These calculations may be microfilmed or electronically scanned if electronic copies are not available. For this reason, calculations shall be printed clearly and with sufficient darkness to assure clarity if reproduction or scanning from the microfilm is necessary. Index calculations in a logical order and include adequate sketches to allow an engineer to follow and comprehend them easily.
- E. Provide a narrative description of purpose, methods, and conclusions for each calculation. Note references (source) for unusual formulas or methods of analysis, including edition of the reference and page number. Include explanation of the method used in computer (or calculator) programs, playback of input data, and clear formats for computer-generated information. Clearly identify numbers in formulas as to the units involved; e.g., psi, gpm, etc. List all assumptions and exceptions, and define all units. Provide copies of tabulated data used. If a computer program was used, provide input file on CD.
- F. Computers: Use the following procedures to perform design calculations with computers:
1. Commercial software may be used if it has been benchmark tested and yields acceptable results when working textbook problems or worked examples in documents such as

ASHRAE or the IEEE Red Book; each calc submittal that is based on commercial software should contain a statement from the AE that the software used has been benchmark tested and provides results that are consistent with results from using the applicable industry standard procedures (such a statement can be based on either certifications from the software companies or benchmark testing performed by the design organization). In addition, other programs can be used that have been approved for use by the LANL Design Authority and, for facility work, the ESM Discipline POC as well. Approvers shall maintain a basis for program acceptance (e.g., benchmark testing and/or standardization).

2. Present complete documentation of new programs used.
 3. Present this information in fundamental language such that an engineer unfamiliar with the program can understand the functions, limitations, and method of analysis used.
 4. Provide sufficient documentation to enable the verification of the method of data input and the interpretation of the output calculations.
 5. Submit plans, flow diagrams, sketches, etc., to completely illustrate the source of input data in such fashion that another engineer can easily check the input data for accuracy.
 6. Present a complete computer listing of input and output data (CD acceptable).
 7. Neatly arrange sketches, input, output, and other material pertinent to the analysis and use 8 1/2 x 11 inch sheets, where practical, and include in the complete analysis presentation. Submit the information for review per LANL Project Management or other established procedures.
 8. Software shall be controlled with a graded approach consistent with LANL LIR 308-00-05, Software Quality Management
http://labreq.lanl.gov/pdfs/ops/01_operations/lir3080005.pdf
Guidance is contained in companion LIG 308-00-05
http://labreq.lanl.gov/pdfs/ops/01_operations/lig3080005.pdf
- G. Calculations shall be prepared in accordance with the design agent's Quality Assurance Plan. For design agents who do not have formal calculation procedures, calculations shall be prepared in accordance with [AP-ENG-605 Developing and Revising Engineering Calculations](#).

11.3 Drawings and Other Outputs

- A. Projects for new systems and buildings shall categorize their drawings and other documents in accordance with Table Z10-2 below⁷. Additional designation of priority documents is the responsibility of the Design Authority. Priority drawings shall be labeled as such per the Drafting Manual.
- B. Project Master Document List (MDL): An index of all project drawings and other documents with number, title, and categories below shall be delivered as a turnover

⁷ These 3-4 categories are suggested by DOE-STD-1073, Configuration Management. They are used throughout the DOE complex where Priority is often called Essential. "Priority" has been in use since the 1990's at LANL, introduced in Sonalyst-authored PWI procedures. They are proceduralized in LIR 240-01-01, Facility Configuration Management and being replaced by the ESM, ISD 341-1 Eng Program Manual, and its APs.

document prior to close-out of the project. A spreadsheet that can be uploaded to the LANL institutional engineering drawing database (e.g., MOADs) shall be submitted when over 5 documents are transmitted. Unless otherwise stated in the Contract Documents, the designer is responsible for populating all required fields of an Excel spreadsheet, saving it as a CSV (comma delimited) file type, and submitting to the LANL Project Manager for subsequent system engineer review, approval, and submission to the Records Center so that they can be entered into MOADs.

C. The fields to be included are:

Fields to Include	Field Data Requirements
Doc. No	
Rev. No	
Title of Doc.	
Approval Date	
Document Type	drawing, report, calc, SDD, etc.
TA	2 digit—e.g., 03
Bldg	4 digit—e.g., 0410
System	per ESM Ch 1 Section 210
System Class	Programmatic or Facility
System Engineer	if known
CM Document Category	Priority, Support, or General
Baseline Type	Input/Design Reqt or Output/Config Mgmt
Doc. Owner	LANL division or facility—e.g., NMT, WETF
Effective Date	if different
Next Review Date	if applicable
Current Status	not assigned, preliminary, approved
DCRM Custodian	ENG-ITS, NMT, etc.
Doc. Classification	U, UCNi
Outstanding FCRs, DCPs, and ECNs	list them
Comments	

Table Z10-2 Document Configuration Management Categories -- Priority, Support, and General

Document Category	Assignment Criteria	Typical Incorporation Time Frame (actual timeframe requirements in CoE Eng Program Manual, ISD 341)
Priority	<ul style="list-style-type: none"> P&IDs and single lines in nuclear, rad, and mod/high hazard facilities Other drawings required to be Priority by other ESM chapters Master Document List for the Priority drawings Operating and surveillance procedures Master Equipment List for the safety-related SSCs Other documents required by Alarm Response, Emergency, or Abnormal Operating 	<p>Revise after field work complete and prior to release to operations. Methods for documenting field work complete are described in AP-WORK documents http://arania.lanl.gov/fmd/. Methods for documenting release to operations may include the Lockout/Tagout Form.</p> <p>Incorporation of amendments into Priority Documents may be extended for 30 calendar days with documented approval by the Design Authority and the Operations Manager. These signatures signify that operations can commence without a safety concern with change paper attached.</p>

	Procedures (and consider the procedures themselves) <ul style="list-style-type: none"> • Required to determine plant event compensatory actions • Required by Technical Safety Requirements (TSR) to clarify technical requirements 	
Support	Information that provides engineering, maintenance, and operations details necessary for plant operations (e.g., process flow sheets, instrumentation, fire protection, etc.)	Revise after release to operations and within 30 calendar days of an amendment determined by the Design Authority to be complex or upon receipt of the fifth field complete amendment. Complex is defined as the inability of the users to interpret the technical baseline document/amendment(s) such that safety and efficient operations are compromised. Ensure unincorporated technical baseline changes are tracked with a status that indicates field completion and a cross-reference to the affected document.
General	Information that provides engineering details necessary for construction (e.g., structural, architectural, civil, etc.).	Revised at the discretion of the Project/Facility Engineering Manager or designee. Ensure unincorporated technical baseline changes are tracked with a status that indicates field completion and a cross-reference to the affected document.
Non-Technical Baseline (NTB)	Reference or legacy documents not intended to be maintained.	N/A

D. Beyond the table requirements above, Appendix A provides a matrix of additional types of technical documents and their suggested CM categories for a typical facility or system; it is guidance and can be used as a starting point to record project drawing requirements.

E. Drawing content and format shall comply with the LANL Drafting Manual.

D. Sealing (Stamping): Comply with the New Mexico Engineering and Surveying Practice Act (Chapter 61, Article 23 NMSA 1978 <http://www.state.nm.us/pepsboard/act.html>) codified in the NM Administrative Code under Title 16, Chapter 39 (esp 16.39.3.12). http://www.nmcpr.state.nm.us/nmac/_title16/t16c039.htm In addition, all plans, calculations, designs, specifications, ECNs, DCPs, reports, and all drawings and diagrams (including P&IDs and PFDs) prepared by consultants or contractors that are involved in the practice of engineering shall bear the seal (stamp) and signature of a professional engineer (PE), currently licensed in New Mexico, in responsible charge and directly responsible for the engineering work. For the purposes of the Act, a licensee of the NM Board “has ‘responsible charge of the work’ as defined in Section 61-23-3, paragraph K, and may sign, date and seal/stamp plans, specifications, drawings or reports which the licensee did not personally prepare when plans, specifications, drawings or reports have been sealed only by another licensed engineer, and the licensee and/or persons directly under his personal supervision have reviewed the plans, specifications, drawings or reports and have made tests, calculations or changes in the work as necessary to determine that the work has been completed in a proper and professional manner.” (16.39.3.12.E)⁸

⁸ The WSS (and similar “do everything” clause in the DEAR, per Y. Salaz) requires that LANL follow New Mexico Regulations: “Requirements of applicable federal, state, and local laws and regulations that address

1. PEs shall only seal those discipline drawings for which they are in responsible charge and directly responsible for the engineering work, none for which they are not.
2. Design-Build: Documents shall be sealed before construction begins. Exceptions: Site preparation and excavation can proceed. Project Managers may authorize construction-start prior to sealing at risk and with ENG Chief Engineer approval.⁹
3. Architectural: Follow the requirement above except that such documents shall bear the seal of a NM-registered architect per the NM Architectural Act based on Article 15 of Ch 61. http://www.nmbea.org/Law/law_frames.htm
4. Exceptions: Fire detection/alarm system and sprinkler design/shop drawings prepared by factory-qualified, NICET Level-III-certified fire alarm contractors need not be sealed ([National Institute for Certification in Engineering Technologies](#)). *If they are to be sealed and a fire protection engineer is not involved, a mechanical engineer could conceivably stamp a fire suppression drawing, as could an electrical engineer stamp a fire detection and alarm drawing, in the rare case such individuals have sufficient demonstrated knowledge, experience, and expertise in this specialized design area.*
5. UC and LANS-employed engineers, performing engineering services involving the operation of LANL, on LANL property, are exempt from the licensing requirements of the New Mexico Engineering and Surveying Practice Act.¹⁰
6. SSS (e.g., KSL) employees shall follow the Acts and this section, and seal design.¹¹
7. Sealing as-built drawings is not always required. *The PE must be in "responsible charge" of any work product they seal/sign. Responsible charge is usually defined as directing the work, making the decisions, and reviewing the final product. Merely reviewing the work does not suffice. State law requires sealing all drawings issued by the AE that are wholly his product. However, red-lines done by a contractor are often not wholly the AE's product. If an AE merely incorporates Contractor's red-lines, then AE should sign the revision but need not seal. If the build team's AE is responsible for 100% inspection and as-building, then the AE should seal.*¹²

11.4 Design/Evaluation Criteria

A. Documentation shall include, but is not limited to, the following:

1. Appendix B (Tech Baseline Requirements); Appendix C (Deliverable Schedule 15-30-60-90/100% for new facilities over \$500k), design basis documents as required by change control procedures (e.g., ECN, DCP) if present; and additional documents required by the project's requirements and other ESM chapters (e.g., Structural Chapter's design basis document, and documents required by Hazardous and Nuclear Chapters).

environment, safety, and health." The New Mexico Engineering and Surveying Practice Act, paragraphs 61-23-3.E, 61-23-21, and 61-23-22 define the practice of engineering and establish qualification and performance requirements for registered professional engineers as a matter of public safety.

⁹ Basis: Helps ensure safety of construction workers, limits LANL liability with safety and unacceptable work.

¹⁰ Memo from Lab Counsel to Tobin Oruch, 7/19/01 (EMref-3). Direct-report (job shop) contractors to LANL are also considered exempt based on NMSA 1978 61-23-22; task-order contractors are not.

¹¹ Basis: Letter, Othmer to Forrester, 11/17/03. (EMref-15)

¹² Memo from T. Oruch to M. Koop dated 3/14/02 (EMref-4) and [ESM Interpretation No. 2002-02, Rev. 0](#).

2. For modifications to existing systems and facilities with technical baseline documents (e.g., Priority drawings), modify the existing drawings using an ECN or DCP process preferentially to creating new drawings. Where this is not possible, create new drawings but add referring notes to existing, affected drawings (or supercede existing drawings as necessary).
3. Equipment Selection Criteria: Include flow rates, pressure or head requirements, operating temperatures, efficiency, energy consumption, and sound ratings. If manufacturer selection program is used, verify that altitude correction for motor size is properly performed.
4. Include copies of catalog sheets showing equipment performance points for all major equipment included in the systems design. *Guidance: For equipment on larger projects (i.e., over \$300k), when CSI format specs are not used for procurement, one or two page data (specification) sheets should be produced. These are common in the chemical processing industry. They are useful for procurement and later by LANL as the starting point for Equipment Data Books (EDBs) useful for operations and maintenance; they contain organized and indexed submittal information. NMT-14 had developed about 100 EDBs for glovebox systems, stand-alone laboratory systems, and facility systems (hardcopy form and eventually electronic form). A draft procedure has also been written for developing EDBs in NMT Division (Guide for Preparing and Maintaining Equipment Data Books) and is available upon request from NMT-14 or ADWEM-AB (DeVolder).*

12.0 ENVIRONMENTAL QUALIFICATION¹³

- A. The requirements identified within this section are for safety SSCs or those systems that provide a mission critical, defense in depth, or worker safety function or whose failure may impact the operation of safety SSCs. For non-safety systems, this section shall be interpreted as guidance that establishes sound engineering practice for the proper and reliable performance of such SSCs.

12.1 General

¹³ The environmental considerations are "good engineering practice" and must be established for safety-related systems to ensure that the environment in which the systems will be placed is conducive to the performance attributes of the selected components. DOE G 420.1-1, Section 5.1.1.3, establishes the requirement for environmental qualification as deemed necessary to ensure reliable performance of a safety system under those conditions and events for which it is intended.

The requirements and guidance within the section are developed through several standards. ASME AG-1, "Code on Nuclear Air and Gas Treatment," Article IA-4000 – Design Considerations, requires the identification of environmental conditions for safety-related systems. Additional requirements and guidance were developed through several standards that identify environmental conditions that could adversely impact the operability of the most sensitive (e.g., I&C) equipment. These standards establish methods to recognize and classify such environmental conditions. The standards are: ISA-71.01, "Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity"; ISA-71.02, "Environmental Conditions for Process Measurement and Control Systems: Power"; ISA-71.03, "Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences"; ISA-71.04, "Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants"; IEEE 1-2000, "Recommended Practice – General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation"; IEEE-1159, "Recommended practice for Monitoring Electric Power Quality"; IEEE-1100, "Recommended Practice for Powering and Grounding Electronic Equipment IEEE Emerald Book."

- A. The environmental conditions in which SSCs must operate or which can affect the proper or continued operation of SSCs shall be clearly identified and considered in design and equipment selection (e.g., the basis for the selected parameters shall be document in the SDD). Normal ambient, abnormal operating, climatic, and event conditions shall be evaluated in the identification of applicable environmental conditions.

The environmental factors that shall be considered when selecting SSC location or SSCs for a location include, but are not limited to, the following:

- temperature and/or humidity extremes
- barometric pressure variations
- airflow
- corrosive atmospheres
- area flooding
- acoustic noise
- electronic noise, or electromagnetic interference (EMI)
- power supply quality (electrical surges, frequency variations, etc.)
- grounding
- lighting
- lightning protection
- physical security
- vibration
- interference from large motors and power feeders
- chemical and particulate (dust) contamination
- radiation
- elevation above sea level
- seismic considerations including proximity to earthquake faults

13.0 EQUIPMENT LOCATION

- A. Maintenance: Mechanical, electrical, controls, and similar equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction, as required by code and as recommended by the manufacturer. Locate equipment in a non-rad, unsecured area (when possible) to facilitate maintenance.¹⁴
1. If safety-related (SC, SS, important-to-safety, hazardous process related) equipment is not accessible with a man-lift or rolling platform, then provide permanent OSHA compliant structures for access to equipment installed 12 feet or higher above finished floors (e.g., HVAC and controls).¹⁵ *Guidance: This requirement should be considered not only for safety-related equipment but for any component that is located 12 feet or higher, especially if frequent access is necessary.*
- B. Outside: Select sites carefully when locating equipment on grade. Ensure that factors such as snow accumulation and drift, ice, windy areas, rainwater from roof overhangs, etc., do not

¹⁴ [LIR/LIG 402-100-01](#), Signs, Labels, and Tags; and 1997 IAPMO UPC, Section 601.2.

¹⁵ 1997 IAPMO UMC, Section 305. Also, DOE-HDBK-1140, "Human Factors / Ergonomics Handbook for the Design for Ease of Maintenance," Section 4.9.3.6, identifies a maximum usage height of 12 feet for a painter's type stepladder. For Safety-Related systems this represents the minimum height for ease of surveillance and maintainability given the potential apparatus available for the performance activities.

affect equipment performance and maintenance. *Avoid locations on the north side of the building.*

- C. Noise: Locate equipment to minimize noise and sound vibration transmission to occupied areas of the building and adjacent occupied areas/structures.
- D. Roofs: Locate equipment a minimum of 10 feet from the edge of roof or inside face of parapet. If the distance is less than 10 feet, specify a 42-inch-high restraint, e.g., guard rails, parapet, screen wall, etc.¹⁶
- E. Security: Consider protecting critical equipment from attack (e.g., gunfire and explosives).

14.0 MASTER EQUIPMENT LIST (MEL)

- A. Projects shall develop project-specific MEL data to include, as a minimum, all safety SSCs and all other facility SSCs requiring maintenance or surveillance as a turnover document prior to close-out of the project. When not entered directly into the MEL, a spreadsheet that can be uploaded to the Computerized Maintenance Management System (CMMS/PassPort) MEL shall be used. Unless otherwise stated in the Contract Documents, the Constructor is responsible for populating all required fields of a spreadsheet, saving it as a CSV (comma delimited) file type, and submitting to the LANL Project Manager for subsequent system engineer review, approval, and incorporation into the MEL. The spreadsheet format to be used is controlled by Maintenance Procedure AP-MNT-010. The format will be made available to external designers upon request (internal link: http://arania.lanl.gov/eng_site/DCRM/dcrm_AP.htm#MNT).

15.0 PROGRAMMATIC APPLICABILITY

- A. The ESM shall be applied to programmatic SSCs as follows:
 - 1. Headings in ESM chapter sections followed by “Programmatic and Facility” or a bold capital “P” or “P&F” help to indicate that subsection shall be complied with by all of LANL, including programs (*this document’s subsection heading “Z1010” on page 3 is an example*).
 - 2. Furthermore, programmatic structures, systems, and components (SSCs) performing the same function as facility equipment shall be considered “facility” from the standpoint of being required to follow the entire LANL Engineering Standards (i.e., follow everything in the ESM, LMS, and Drafting Manual. Examples include buildings, transportables, HVAC equipment, electrical equipment, etc.). Standards Discipline POCs are the delegated Authorities Having Jurisdiction (AHJ) for judgments on this (appeals to the ENG Chief Engineer and, if necessary, higher).
 - 3. *Many basic facility SSC functions are defined by ESM Chapter 1 Section 210, System Lists (see Table 210-A1-1 for common systems).*

¹⁶ 29 CFR 1926.501(b)(1) requires fall protection when the working distance from the equipment is 6 feet or less; 10 feet minimum distance allows for equipment door swings and removal of equipment.

16.0 REPAIRS, ALTERATIONS, CHANGES OF OCCUPANCY, ADDITIONS, HISTORIC BUILDINGS, AND RELOCATED BUILDINGS

- A. IEBC: Comply with the 2003 or 2006 International Existing Building Code and its Appendices A and B.¹⁷ In addition, use materials and methods described by the Engineering Standards for all repairs and alterations (as defined by the IEBC). Consistent with the "Conflicts" section above, these IEBC requirements supersede the 50% value rule that exists in some ESM chapters (except for non-facility systems; see below).
- B. The ENG Chief Engineer is the Authority Having Jurisdiction for interpretations, conflict resolution, and variances on the IEBC and code-of-record issues (e-mail acceptable).
- C. *The IEBC is online for LANL at <http://lib-www.lanl.gov/infores/stand/ihs/index.htm> (NOTE: Many users will only need the first 13 chapters, not the long appendices, and can stop printing at page 78 of the 301-pg file for the 2003 edition).*
- D. The IEBC shall be interpreted as follows:

IEBC Reference/Term	Take to mean
building/code official	The LANL Engineering Division Chief Engineer, who is charged with code setting and decision making by IMP 342, Engineering Standards.
Int'l Building Code	ESM Structural Chapter 5
Int'l Electrical Code	ESM Electrical Chapter 7. Also, the ESM shall be followed in all cases regardless of where the IEBC may allow something inferior (e.g., 408.1.3).
Int'l Energy Consvr Code	ESM Sustainable Design Ch 14
Int'l Fire Code	ESM Fire Chapter 2
Int'l Fuel Gas Code	ESM Fire Chapter 2
Int'l Mechanical Code	ESM Mechanical Chapter 6
Int'l Plumbing Code	ESM Mechanical Chapter 6
Int'l Property Maintenance Code	LANL policies and procedures on facility maintenance (including O&Ms, IMPs, ISDs, LIRs, APs, etc.)
jurisdiction	LANL. See also building/code official.
lot line	In the context of a construction project, the location of the physical barrier (e.g., fence or barrier) surrounding a site.
National Electrical Code	NFPA 70, <i>National Electrical Code</i>
owner	The facility managing organization, typically the Responsible Div Leader or Facility Director
Unsafe Condition (115.1, 202)	Further defined for electrical as not conforming to NFPA 70E, <i>Standard for Electrical Safety in the Workplace</i> .

- E. Other amendments to the IEBC shall be made for LANL as follows (based on 2003):

¹⁷ IEBC was adopted by New Mexico effective July 1, 2004; a multi-disciplinary team determined that it was appropriate for LANL (ref EMRef-37 -- IEBC Meeting Minutes of 11-10-2004). As of 1/06, it had been adopted by 12 states and 13 other jurisdictions per <http://www.iccsafe.org/government/stateadoptions.pdf>

CHAPTER 1 ADMINISTRATION

101.4 Existing buildings. Deleted.

101.6 Safeguards during construction. Deleted.

101.7 Appendices. Delete and substitute: Appendices A and B are adopted.

101.8 Correction of violations of other codes. Deleted.

102.4.1 Standards and guidelines for structural evaluation. Deleted.

102.5 Partial invalidity. Deleted.

103 - Department of building safety. Deleted.

104 - Duties and powers of the code official. Deleted.

105 - Permits. Deleted.

106 - Construction documents. Deleted.

107 - Temporary structures and uses. Deleted.

108 - Fees. Deleted.

109 - Inspections. Deleted.

110 - Certificate of occupancy. Deleted.

111 - Service utilities. Deleted.

112 - Board of appeals. Deleted.

113 - Violations. Deleted.

114 - Stop work order. Deleted.

115 - Unsafe buildings and equipment. Deleted.

116 - Emergency measures. Deleted.

117 - Demolition. Deleted.

CHAPTER 2 DEFINITIONS

202. General definitions. See this section of the IBC except as follows:

(1) Add: CODE OFFICIAL means the ENG Division Chief Engineer.

(2) Delete the definition for CHANGE OF OCCUPANCY and substitute: means a change in the use of an existing building such that the occupancy classification applicable to the new use is different from the occupancy classification of the former use.

CHAPTER 5 ALTERATIONS – LEVEL 1

506.2 Alterations affecting an area containing a primary function. The second sentence is amended to provide: “The accessible route to the primary function area shall include toilet facilities and drinking fountains serving the area of primary function.”

507.1 General. Delete “or where a reroofing permit is required”

507.2.2 Parapet bracing and wall anchors for reroof permits. Deleted

CHAPTER 6 ALTERATIONS - LEVEL 2

610.1 Minimum fixtures. Deleted.

CHAPTER 12 COMPLIANCE ALTERNATIVES

Deleted, to be used only with prior ENG Chief Engineer ok and approval of calcs and outcome.¹⁸

CHAPTER 13 CONSTRUCTION SAFEGUARDS. Required for areas resembling urban or campus, including all of TA-3 and within the TA-55 fence. Not required for areas resembling rural/industrial due to lower pedestrian density/risk.

¹⁸ Deletion recommended by ENG DECS CSA Team 7/11/05; see EMRef-50

- F. For systems outside the IEBC scope (e.g., programmatic equipment), bring existing such systems and subsystems into compliance with current codes and requirements in the ESM when renovation or other upgrade work includes major replacements, modifications, or rehabilitation that exceeds 50% of the estimated replacement value¹⁹ of the existing structure, system or subsystem.²⁰ Consider upgrading whenever safety is an issue.
1. This requirement applies on a system or subsystem basis (e.g., a glovebox system, an HVAC train, a non-building structure, etc.). Many systems and subsystems are listed in Section 210 of ESM Chapter 1.
- G. The LANL AHJ has the authority to require upgrade of any or all of a system to current code on a case-by-case basis (regardless of percentage) when safety is a concern.
- H. Under certain circumstances when allowed by the Design Authority and LANL AHJ, the “codes of record” can be applied to later modifications, replacements, or rehabilitation projects involving less than 50% of the estimated replacement value, when justifiable.

17.0 SHED AND CONTAINER REQUIREMENTS

- A. Sheds include storage buildings, garages, and carports made by Morgan, Tuff Shed, etc. Containers include transportainer, SeaLand, SeaTrain, and similar steel shipping/storage boxes. All are considered structures and, as such, are subject to the following requirements for customization and installation in addition to national code and standard requirements applicable to such structures.

NOTE: Construction contractor structures in an approved project lay-down area are exempt

- Anchorage: Tie down with wind straps or other anchorage approved by LANL ENG.
- Bonding: Electrical bonding to a ground system (as is done with fences/gates) is suggested for personnel safety reasons should lightning strike nearby.
- Clearances/Siting: Get siting approval via the Site Planning LIR/IMP. Comply with underground utilities and overhead power line right-of-way requirements in ESM Civil and Electrical Chapters (see Chpt 3 Civil G30 part 9.0 and 10.0). If there will be adjacent structures, follow ESM Fire Chapter for exposure acceptance criteria (e.g., [DOE-STD-1088](#), DOE Standard on Fire Protection for Relocatable Structures -- placement in accordance with Table in section 6.1, a simplification of NFPA 80A techniques [the primary concern from these are the fire exposure they pose to more permanent and valuable structures]; Section 6.2 provides rules of thumb about placement; etc.).
- Hazardous Material Storage: Sheds and containers should not be used for this; instead, use lockers or cabinets designed for safe storage (and containment if appropriate) and labeled for the purpose (e.g., NFPA 704 diamond); see also ESM Ch 10.

¹⁹ Replacement value determined using typical LANL cost estimating procedures.

²⁰ This is necessary to assure that significant renovations are more than just skin deep. Over time, this requirement will bring about safety, functionality, and efficiency upgrades to the underlying SSCs. This percentage was accepted by the TRB (now ESB) on 7/19/00. Fifty percent was also used in the 2001 Santa Fe County Urban Wildland Interface Code for use of fire resistant materials in renovations and for the total luminaire replacement requirement in ASHRAE/IESNA 90.1-2001, Section 4.1.2.2.5. Fifty percent of total square footage is also used for Level 3 alterations per Chapter 3 of the IEBC which was adopted by New Mexico effective 1 Jul 2004.

- Lightning Protection: This is typically not required because containers are normally used for low-value goods; however, if loss due to lightning-induced fire would be over \$100K, follow ESM Electrical Chapter requirements for making a needs determination (uses NFPA 780 exposure and importance criteria).
- Occupancy: Shipping containers shall not serve as occupied work areas. They are intended by design for shipping and storage purposes only. Personnel time inside shall be infrequent, of short duration, and controlled – and comply with basic life safety issues such as asphyxiation/confined space entry, stability of stacked materials, and IBC egress pathway. Structures for use in occupancy are covered by the IBC and must conform for that specific occupancy type.
- Signage: As described in ESM Arch Ch 4, structure number signs are required.

18.0 SIGNS, LABELS, AND TAGS

- A. Identify SSCs in accordance with the nomenclature indicated in LANL Engineering Standards Manual, [Chapter 1](#), Section 200, Equipment/Component Numbering/Labeling.
- B. Label SSCs in accordance with:
 - LANL Master Specification Section 22 0554, Identification for Plumbing, HVAC, and Fire Piping and Equipment;
 - LANL Master Spec 26 0553, Identification for Electrical Systems; and
 - ESM Chapter 1, Section 240, Labeling (future).
- C. Building/structure signage (including wayfinding signage) is addressed in ESM Chapter 4, Architectural (Section B-C_GEN).
- D. *Guidance: Additional information on labeling may be found in the LANL Conduct of Operations Implementation Manual [OST 310-00-00](#) (Section 4.18 addressing Chapter 18 of the ConOps order; becoming IMP 321 etc.).*
- I. For other signs refer to [Signs, Labels, and Tag LIR402-100-01](#), associated [LIG 402-100-01, Signs, Labels, and Tags](#), and the online “[Sign Catalog](#).”
- J. Labeling: In addition:
 - Mechanical equipment labeling is described in ESM Mechanical Chapter 6 Section D10-30GEN.
 - Electrical equipment labeling is described in ESM Electrical Chapter 7 Section D5000.
 - Chemical container labeling is described by [Chemical Management LIR 402-51-01](#).

19.0 SPECIFICATIONS

- A. When a LANL Master Specification Manual (LMS) section (“spec”) applicable to the work at or for LANL exists, its requirements shall be followed regardless of who performs the work or the authorizing or contractual methods used to initiate the work.
- B. When editing the LMS specification templates to suit the project, add job-specific requirements and delete only those portions that in no way apply.
- C. To seek a variance from applicable LMS requirements, contact the ES discipline POC.
- D. A CSI-format spec package (book of sections) adequately describing the work shall be prepared by the Design Agency and followed by the Contractor whenever any of the following criteria are met:
 - 1. The work is ML-1 or ML-2.
 - 2. The estimated construction cost is \$300k or more.

NOTE: Both the Chapter 1 and ESM POC of the most-affected discipline can grant variance to the above.

Guidance: A CSI spec package is recommended for all other projects, and especially when multi-discipline or complex. Very basic projects may be able to capture needed instructions elsewhere (in ECN or DCP instructions, sketches, or drawings). Specifications are preferred over extensive drawing notes.

- G. Specification packages (“books”) shall comply with LMS general requirements (e.g., Section 200) including Table of Contents, approval sheet, format, language, and tailoring of spec to match project requirements (including deletion of unneeded subsections and paragraphs). Books and single sections shall also have footers with project ID, section number and “X of Y” page numbering. *Guidance: Technical spec sections should be bundled together with the Division 1 general requirements sections (e.g., Submittal Procedures, Product Options & Substitutions, and Project Record Documents, etc.)*
- H. Number added (non-LMS) specification sections in accordance with the CSI MasterFormat 2004 system. The minor numbering differences between MasterFormat and the major commercial spec services are allowed (i.e., MasterSpec, SpecText, BSI). The designer shall correct LMS sections to properly reference other LANL sections used as necessary -- and designer-added sections (and visa-versa). NOTE: LMS sections were being renumbered to the CSI MasterFormat 2004 system in February 2006. ESM references to the sections are being correcting gradually; in the meantime, a crosswalk from old to new numbers/titles is available on the specs webpage.
- H. Buy American Act: Comply with this Act ([41 U.S.C. 10a - 10d](#)) and Executive Order 10582, December 17, 1954. *Guidance: When LANL is the purchaser of goods, the key provision of LANL policy is that American products should be specified except when it is not likely that the lowest acceptable offer for a domestic end product or construction material will exceed the lowest acceptable offer for a foreign end product or foreign construction material,*

inclusive of duty, by more than 6% if the domestic offer is from a large business, or more than 12% if the domestic offer is from a small business concern.”²¹

- I. ML-1/ML-2: Draft changes from LMS spec sections for ML-1/ML-2 SSCs shall be produced using Word Track Changes (*deletions should be ~~Strikethrough~~ and additions be **bold** text with a right border line*).

 1. Electronic review drafts shall be made available to LANL reviewers upon request.
 2. Hardcopy drafts and finals shall have all tracking removed (changes accepted; plain, clean text).

- J. ML-1/ML-2: Warning: Many LMS specs were not written for ML-1/ML-2 projects and therefore did not receive independent review before issuance (this is being stated in those specs as they are being revised; however, some do not include this warning as yet). ML-1/ML-2 projects shall ensure that their final specs contain adequate QA requirements and have received independent technical review by a qualified reviewer. *Guidance: Typical additions for ML-1/2 specs are intended to increase reliability as appropriate for the credited functions in the documented safety analysis, and may include: seismic and other environmental qualification requirements including system interaction, qualifications of designers and installers, more detailed construction submittals, more rigorous material receipt and control, and more rigorous field quality control, test and inspection, traceability of materials. Good examples of ML-1/2 specs are LMS Sections on gloveboxes (11 5322.XX series).*

Z1020 QUALITY REQUIREMENTS (PROGRAMMATIC & FACILITY)

- A. Projects shall comply with applicable LANL QA requirements documents. *These may include:*
 - [*DOE O 414.1B, Quality Assurance*](#)
 - [*DOE G 414.1-2, Quality Assurance Management System Guide for use with 10 CFR 830.120 and DOE O 414.1*](#)
 - [*10CFR830 Nuclear Safety Management, SubPart A, Quality Assurance Requirements*](#)
 - [*IP300-SD3 LANL Quality Assurance Program*](#)
 - [*ISD 330-6, Nonconformance Reporting \(per implementation schedule\)*](#)
 - [*LANL LPR 308-00-00, Institutional Quality Management*](#)
 - [*LANL ISD 824-1, Procurement Quality*](#)
 - [*LANL LIR 308-00-05, Software Quality Management*](#)
 - [*LANL LIG308-00-05, Software Quality Management*](#)
 - [*Institutional SQM Website \(internal\)*](#)
 - *Additional requirements in other ESM chapters*

²¹ UC Procurement Standard Practices (SP) 25.1 Buy American Act and Balance of Payment Program 4/24/02
http://labs.ucop.edu/sp-labs/lanl/t_2501.pdf

- Division or project-specific QA requirements
 - Documents in OE Quality Assurance Toolkit <http://int.lanl.gov/orgs/oe/topics/qa.shtml> and references <http://int.lanl.gov/orgs/oe/topics/qatoolkit/qa1.shtml>
- B. Safety Class, Safety Significant, vital safety system, ML-1, and ML-2 items typically require use of suppliers from the PS-1 Institutional Evaluated Supplier List (IESL) <http://ps.lanl.gov/source/orgs/ps/ps1/pdfs/IESL.pdf> and/or use of a commercial grade dedication process (see [ISD 330-10](#), Commercial Grade Item Dedication). For nuclear safety-related projects, see ESM Chapter 12--Nuclear, Quality Assurance Subsection, for additional requirements (*including 10CFR830*).

Z1030 TEMPORARY FACILITIES (FACILITY)

- A. For buildings, additions, transportables, trailers, sheds, containers, and similar structures, **permanent** is defined as intended to be in place for 3 years or longer; **temporary** is defined as less than 3 years. (*In siting requests, "substantial and permanent" refers to also having an initial total project cost of greater than \$100,000*).
- B. Temporary facilities are **not** required to meet ESM requirements that reduce the life-cycle cost of permanent facilities. Temporary facilities **are** required to meet all DOE contractual requirements as well as all ESM requirements for security and safety/health of occupants, the public, and the environment. Sheds and containers have additional requirements in this Section Z10.
- C. The ENG Chief Engineer has the authority to interpret and grant variance to this section (Z1030) and related requirements in other ESM chapters. *Guidance: The requestor may be asked to submit life-cycle analysis.*
- D. *Guidance: For subcontracted construction work, the Contract may contain requirements for the Contractor regarding temporary facilities to support construction (e.g., offices, restrooms in the boilerplate or Spec Section 01 5200).*

Z1040 PROJECT CLOSEOUT (FACILITY)

- A. At the completion of facility projects, transmit drawings, specifications, and other project records to ENG in accordance with LANL Master Specifications Section 01 7839, Project Record Documents (or project-specific spec section with equivalent or superior requirements). *For projects subject to review beyond the facility managing organization, this should be done as a project submittal through the ENG technical review process. When the project is not subject to such review, send directly to ENG Document Control & Records Management (DCRM) Team, K788, at TA-63-121.*
1. Records shall be sent to satellite records centers only when ENG's DCRM team has agreed to such arrangements in writing.
 2. For drawings, follow additional requirements for transmittal in the LANL Drafting Manual.

3. For major projects subject to the Construction Project Management LIR, follow PMD Procedure 606, Project Acceptance and Closeout.
4. Transmit all submittals electronically in addition to any hardcopy requirements in native format (e.g., Word, AutoCAD, etc.).

APPENDICES

APP A TECHNICAL BASELINE DRAWINGS GUIDANCE

APP B TECHNICAL BASELINE DELIVERABLES (NEW FACILITIES)

APP C DELIVERABLE SCHEDULE 15-30-60-90/100% (PROJECTS OVER \$500K)

APP D FACILITY DESIGN DESCRIPTIONS (NEW FACILITIES)

APP E LIFE CYCLE COST METHODOLOGY GUIDANCE

ATTACHMENTS

ATT 1 ESM CLARIFICATION/INTERPRETATION FORM, FM1

ATT 2 ESM VARIANCE AND EXCEPTION FORM, FM2